

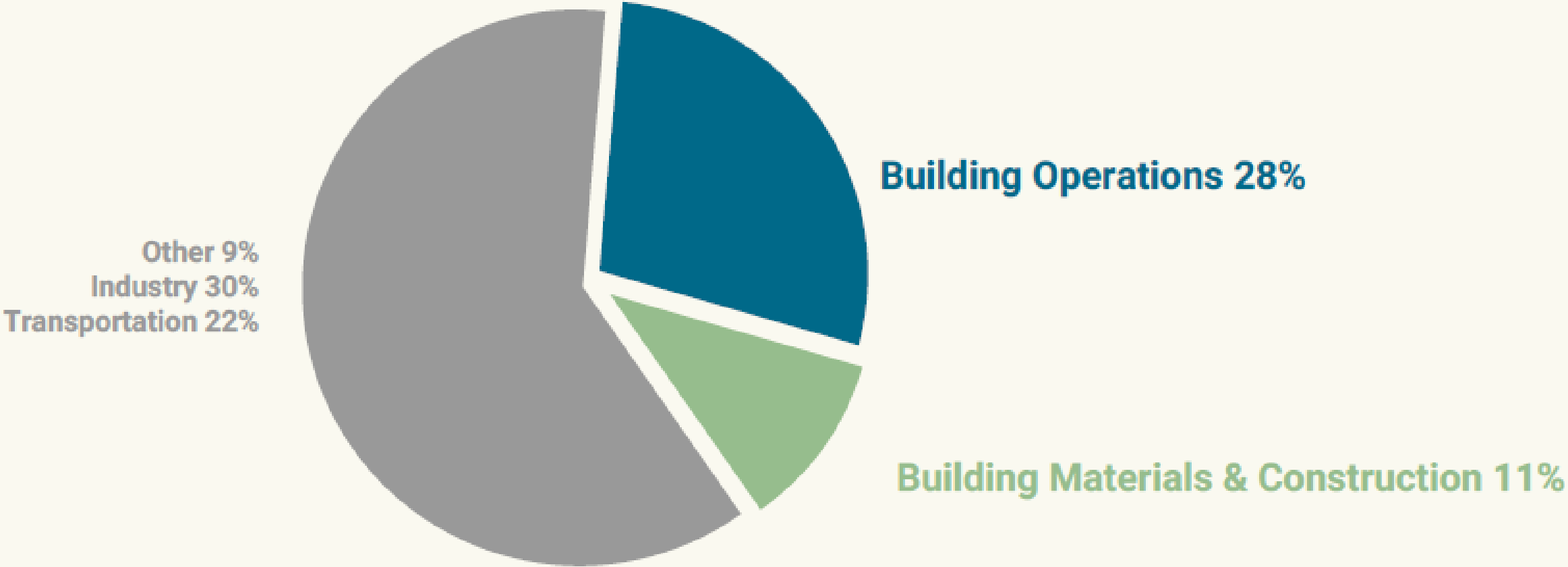
Moran Square, Fitchburg, MA

Low Carbon Historic Retrofit



**Rees Larkin Development, TAT,
Biome Studio, Petersen
Engineering, Building Science
Corporation, New Frameworks,
Advanced Building Analysis,
Keith Construction**

Global CO2 Emission by Sector



- Architecture 2030

Decarbonize Moran Square

1. leveraging embodied carbon – existing building

2. operational carbon – PHIUS Passive House & solar

3. low carbon & carbon storing materials



Micron Products, Inc

Boston Coupon Clippers

Urban Flow La Moda

Sawyer Passway

Sawyer Passway

2A

Myrtle Ave

Main St

Summer St

Fleetwood

My Turn









● MAIN ST



by Google



Main St
Fitchburg, Massachusetts



Street View - Sep 2018



Google

44 units of affordable housing


NEW CONSTRUCTION MATERIALS KEY

- ALUMINUM COMPOSITE METAL PANEL CORNICE
- uPVC FRAME HIGH PERFORMANCE WINDOWS, CHARCOAL COLOR
- CASTSTONE SILLS AT ALL WINDOWS
- RED MODULAR BRICK AT LEVELS 2-5
- GREAY MODULAR BRICK INFILL AT LEVELS 3-4
- MODULAR BRICK SOLDIER COURSE HEADERS

- ALUMINUM FRAME STOREFRONT ENTRY SYSTEM
- ALUMINUM COMPOSITE METAL PANEL AWING AT MAIN ENTRANCE

- GRANITE VENEER WALL BASE
- uPVC FRAME WINDOWS WITH ALUMINUM COMPOSITE METAL PANEL HEADER
- WINDOW PLANTER BOXES, CHARCOAL COLOR
- GRAY MODULAR BRICK AT LEVEL 1
- CAST STONE SILLS AT ALL WINDOWS
- MODULAR BRICK ROWLOCK COURSE ALIGNED WITH WINDOW SILLS



A large, horizontal yellow oval with a slight gradient, centered on a white background. Inside the oval, the text "carbon storing materials" is written in a bold, black, sans-serif font, arranged in three lines.

**carbon
storing
materials**

CRADLE-TO-GATE

“Embodied Carbon (eCO₂e) is the sum impact of all the greenhouse gas emissions attributed to the MATERIALS throughout their life cycle.”

Material extraction

Manufacturing + Production

Construction

Use

End of life

refurbish

reuse

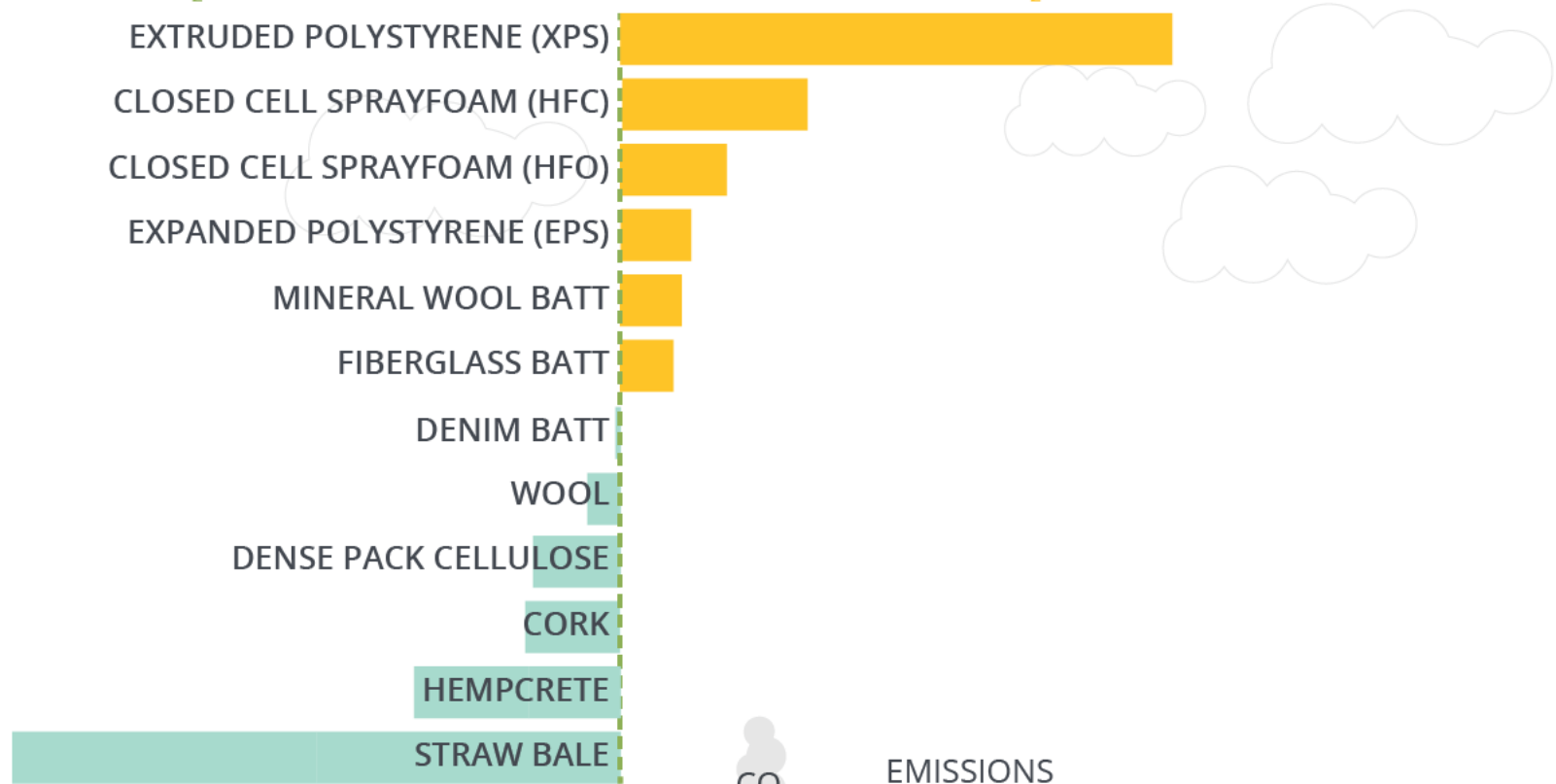
recycle

<http://carbonleadershipforum.org/>

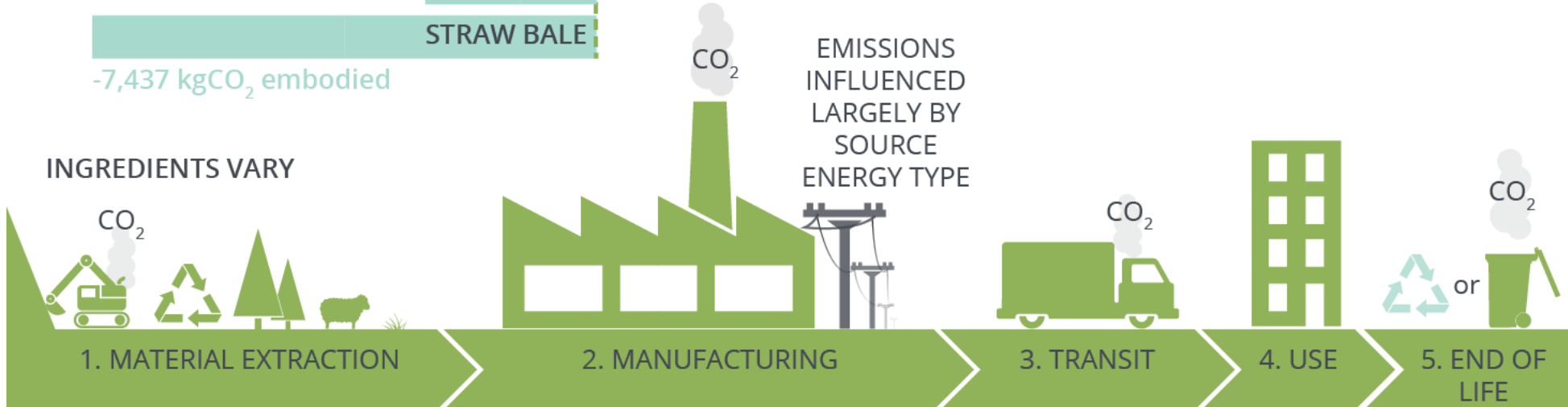
CARBON IMPACTS OF INSULATION

kgCO₂ represents R-20 at 234 m²

6,735 kgCO₂ emitted

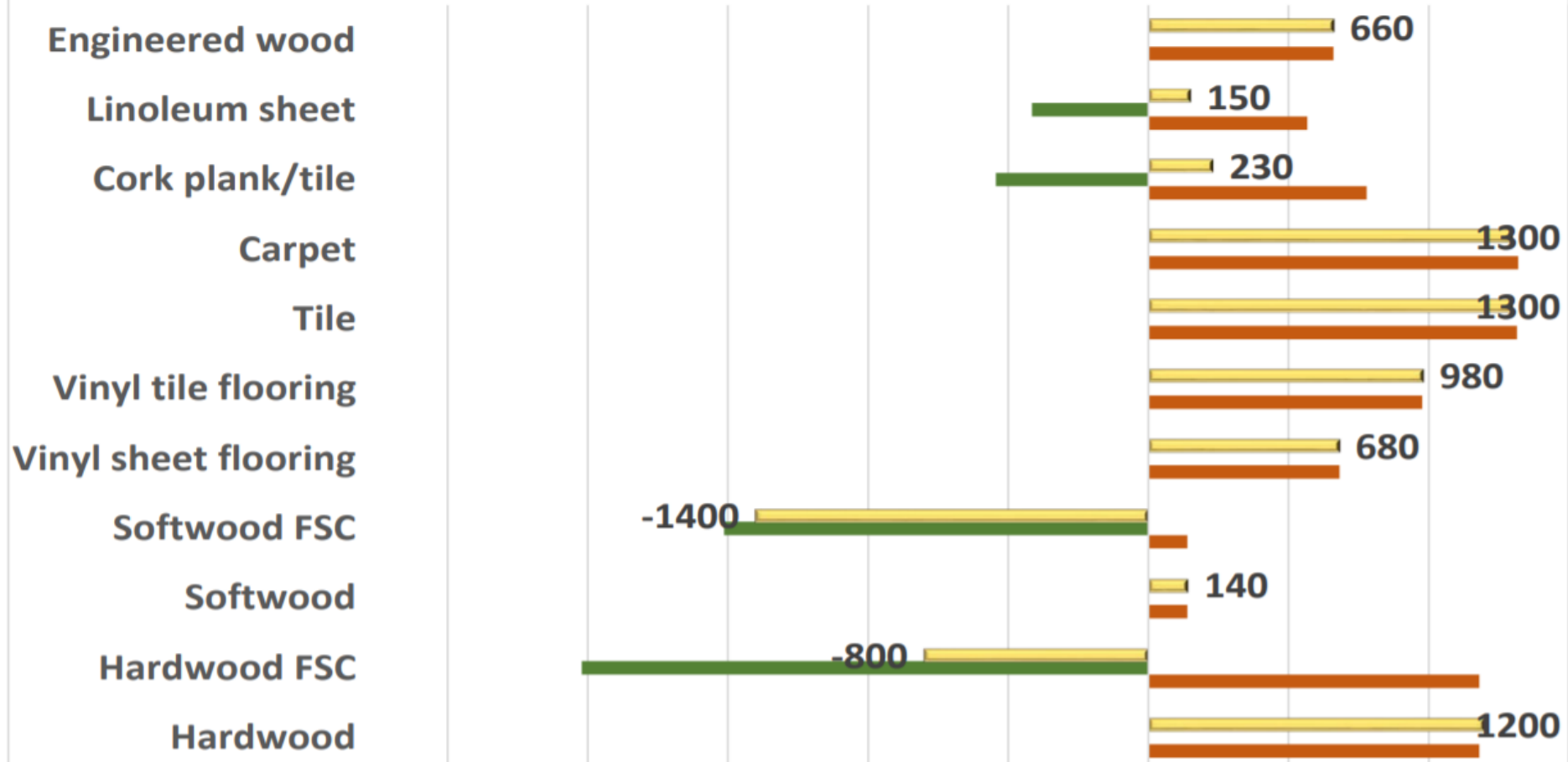


-7,437 kgCO₂ embodied



Embodied CO2e Emissions by Flooring Type, kg eCO2e per 100 m2 flooring

■ Total eCO2e Emissions
 ■ eCO2e Storage
 ■ eCO2e Emissions



Carbon storing materials palette

plant-based, carbon-storing building materials



and no red list chemicals!

 **EPD**® ENVIRONMENTAL
PRODUCT
DECLARATION
THE INTERNATIONAL EPD® SYSTEM



Our sources of data:

- Industry average EPD for North America
- Product specific EPD for North America
- Industry average EPD for Europe
- Product specific EPD for Europe
- LCA data from peer reviewed sources
- ICE database

A low-angle, upward-looking photograph of a modern building's interior or exterior structure. The image features several large, cylindrical concrete pillars and horizontal concrete beams. The concrete has a textured, slightly weathered appearance. The sky is a clear, bright blue, visible through the gaps between the structural elements. The perspective creates a sense of height and scale.

concrete!

8% of global greenhouse gas emissions

Use Less Materials!

Low Carbon Materials

1. **Concrete** – Increase Fly Ash and Reduce Portland
2. **Insulation** – Cellulose, Mineral Wool, Eco-Fiberglass, Glavel, Low HFO Foam
3. **Studs** - Wood Instead of Steel
4. **Flooring** – Reuse wood, Marmoleum, Interface LVT (zero carbon)
5. **Sheetrock** - Ecosmart

**cut operational
carbon!**

**PHIUS Passive
House + solar**

Passive House (PHIUS)

Continuous insulation without thermal bridging

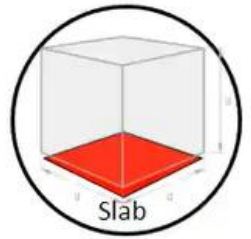
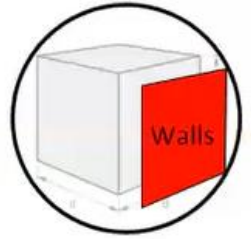
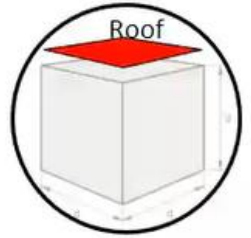
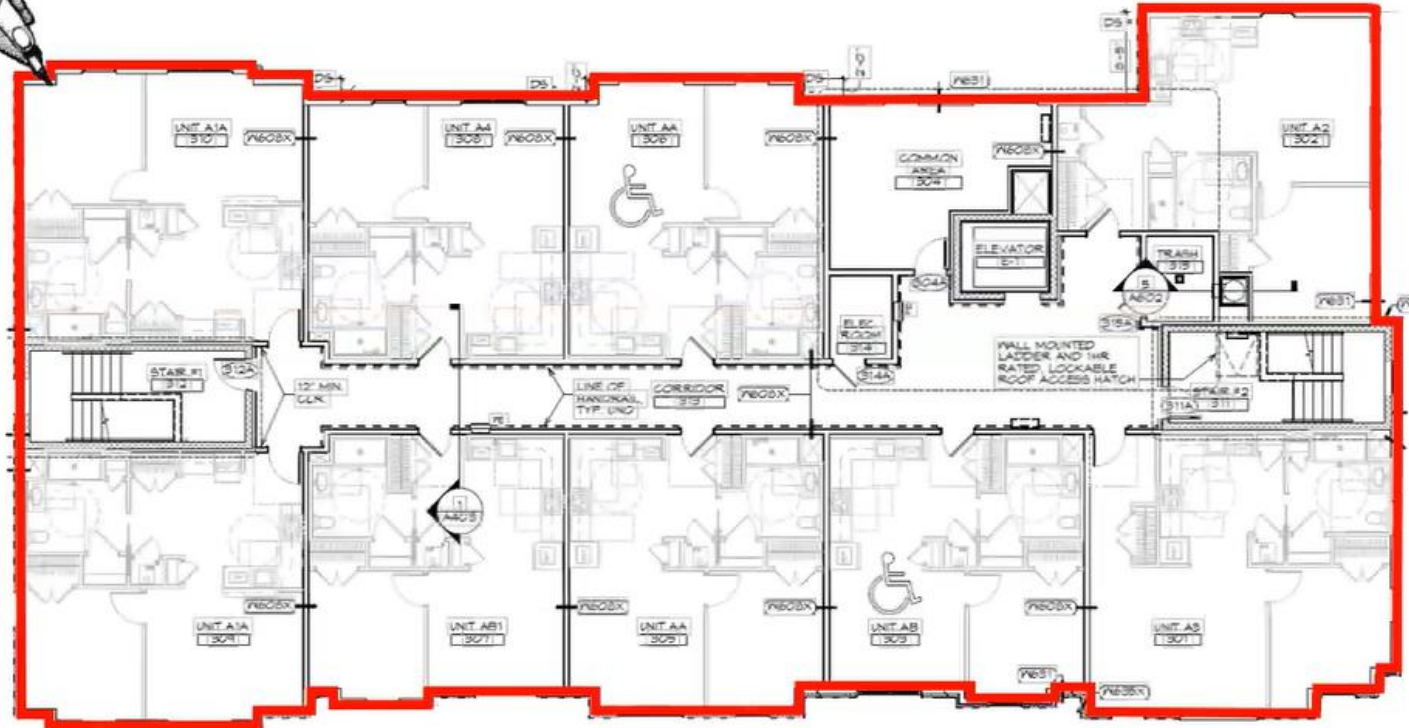
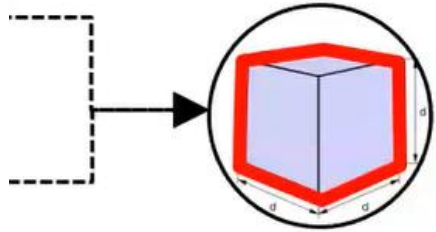
Airtight

High performance windows & doors

Heat & moisture-recovery ventilation

Minimal space conditioning

AIR BARRIER



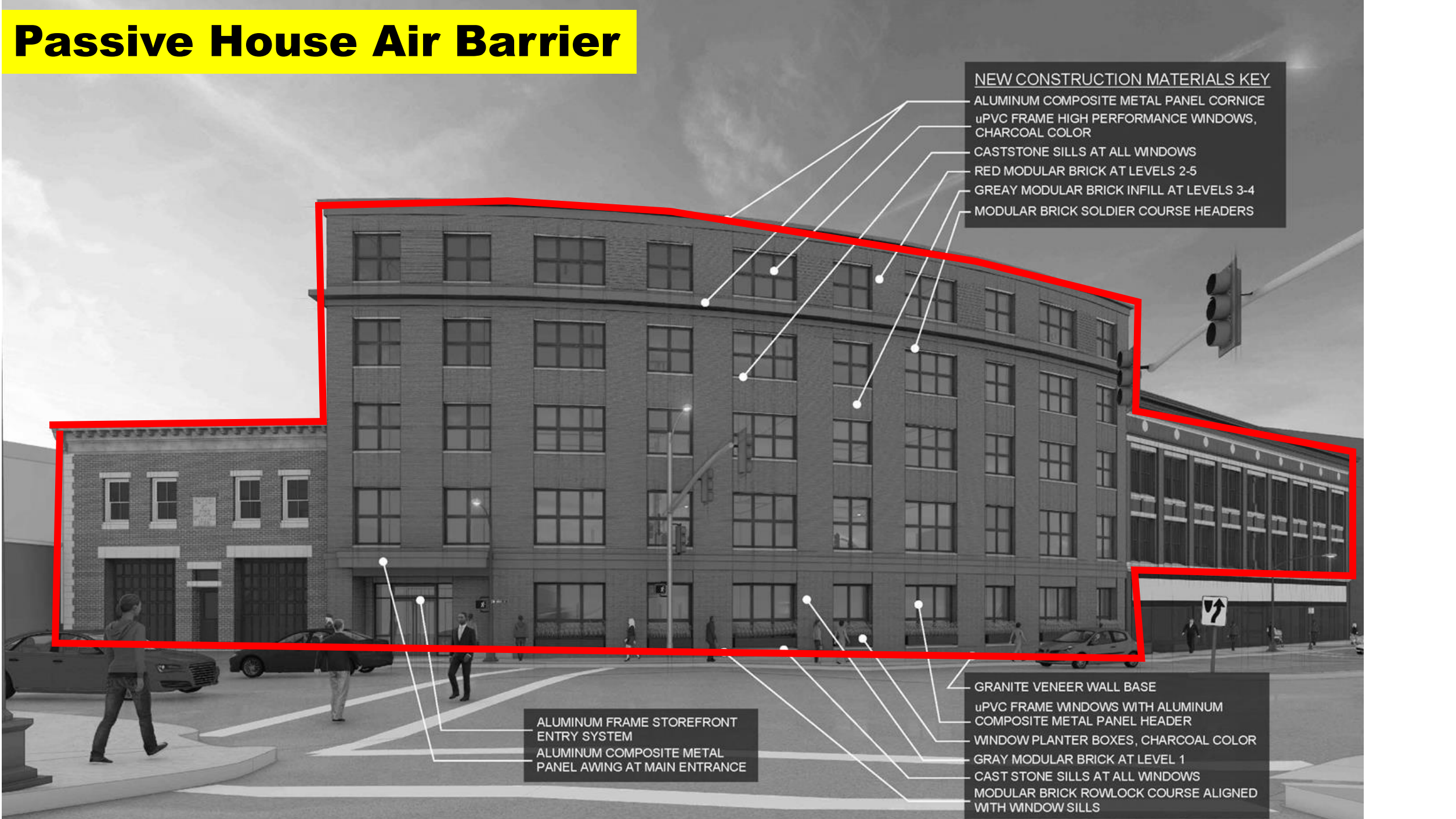
Passive House Air Barrier

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Federal Historic Tax Credits

Moran Square = Good Candidate for Passive House

- 1. simple architecture**
- 2. simple windows**
- 3. limited interior exposed brick**



National Park Service Standards and Guidelines

- 1. Windows!! - Casement to Meet Air Infiltration Goals**
- 2. Wall Section Depth**
- 3. Exposed Brick**
- 4. Thermal Bridges**
- 5. Nothing Visible from the Exterior**
- 6. New Building – Brick Facade**

Windows!





Simulated Double Hung Casement Windows! - $U < .14$



- diagram from Zola



- photo from Zola

National Park Service

tat

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 Chelsea MA 02150
 ☎ 617.889.4402
 ✉ 617.884.4329
 architecturalteam.com



SYNDICATE BLOCK - EXISTING 2ND FLOOR WINDOWS

Consultant:

Revision:

Architect of Record:

Drawn: BW

Checked: GK

Scale: 1" = 1'-0"

Key Plan:

Project Name:
**MORAN SQUARE
 REDEVELOPMENT**

15 SUMMER ST & 10
 MAIN ST - FITCHBURG

Sheet Name:

**EXTERIOR WINDOW
 ELEVATIONS -
 SYNDICATE BLOCK**

Project Number:

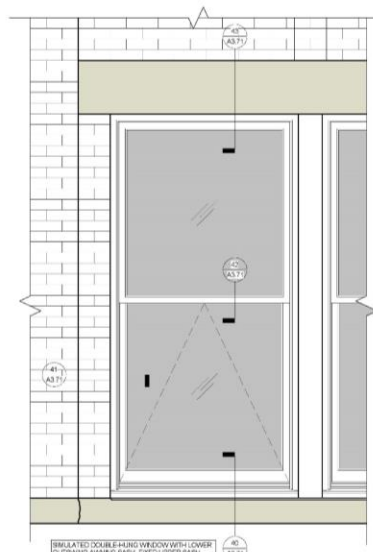
17009

Issue Date:

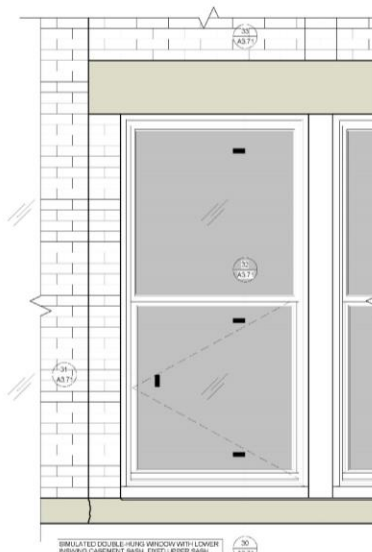
09/16/19

Sheet Number:

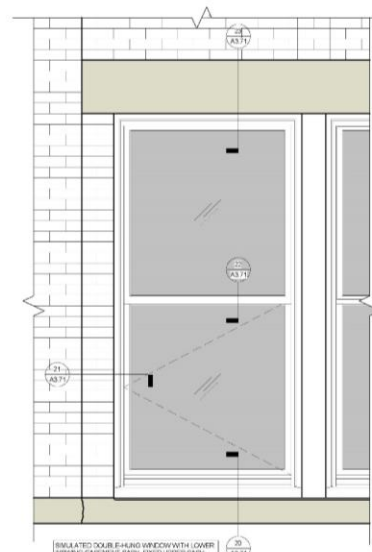
A3.70



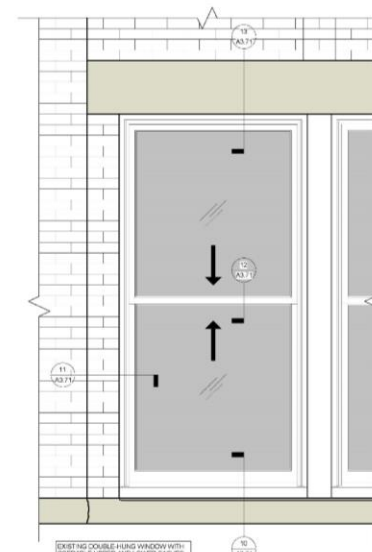
40 SYNDICATE BLOCK - BEWISO KLEOPATRA WINDOW ELEVATION
 Scale: 1" = 1'-0"



30 SYNDICATE BLOCK - BEWISO ANNE WINDOW ELEVATION
 Scale: 1" = 1'-0"



20 SYNDICATE BLOCK - ZOLA WOOD WINDOW ELEVATION
 Scale: 1" = 1'-0"



10 SYNDICATE BLOCK - EXISTING 2ND FLOOR WINDOW ELEVATION
 Scale: 1" = 1'-0"

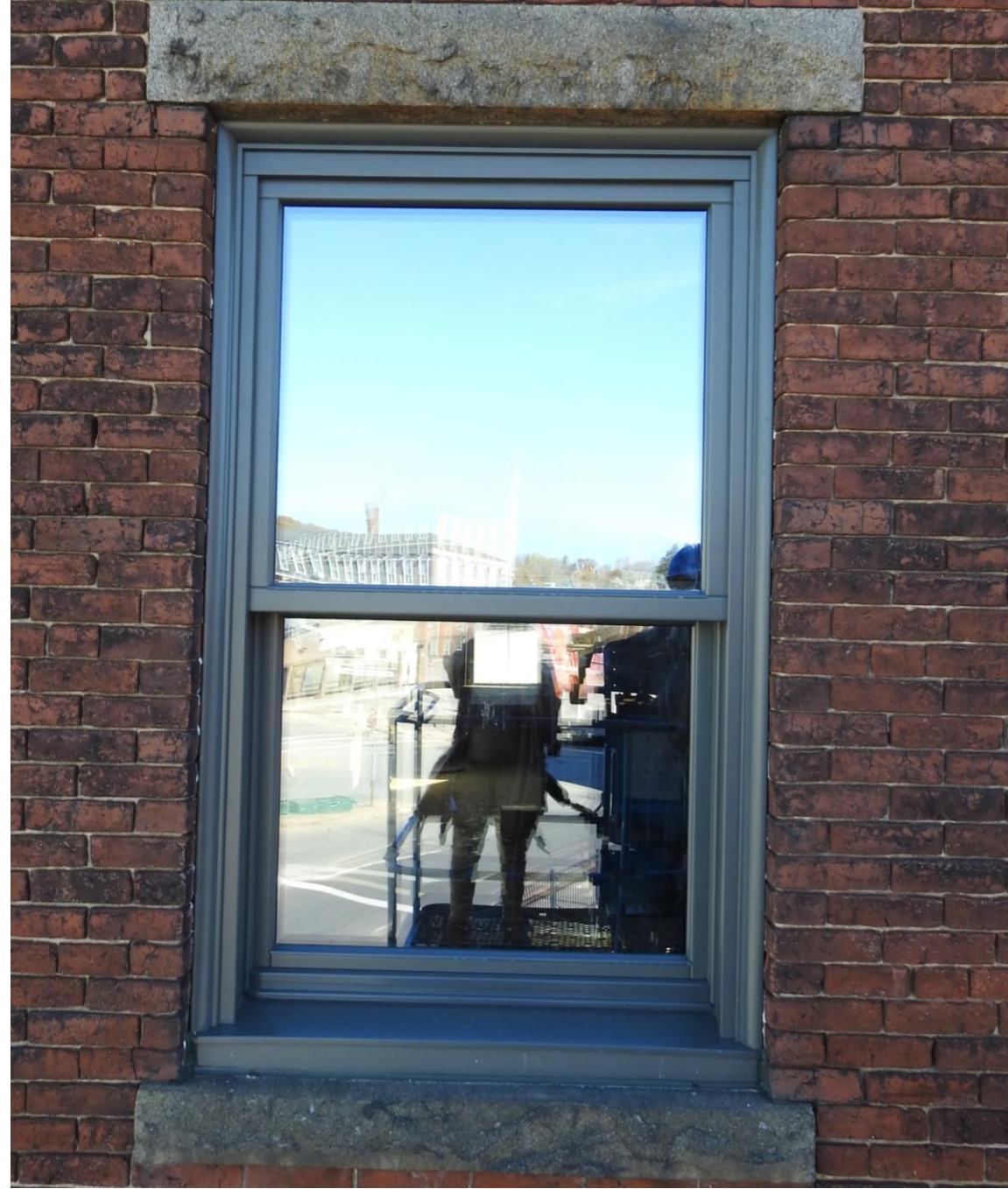
8/16/2019 12:38:46 PM
 C:\New Local 2019\17009_1710_10_Main Street_SyndicateBlock\A3.70.rvt



Yaro Installation – Mockup



Original Historic Window



Simulated Double Hung Casement Window

Solar Heat Gain Coefficient – Too Reflective!



Better = SHGC .49

Too Bulky



Installation 1

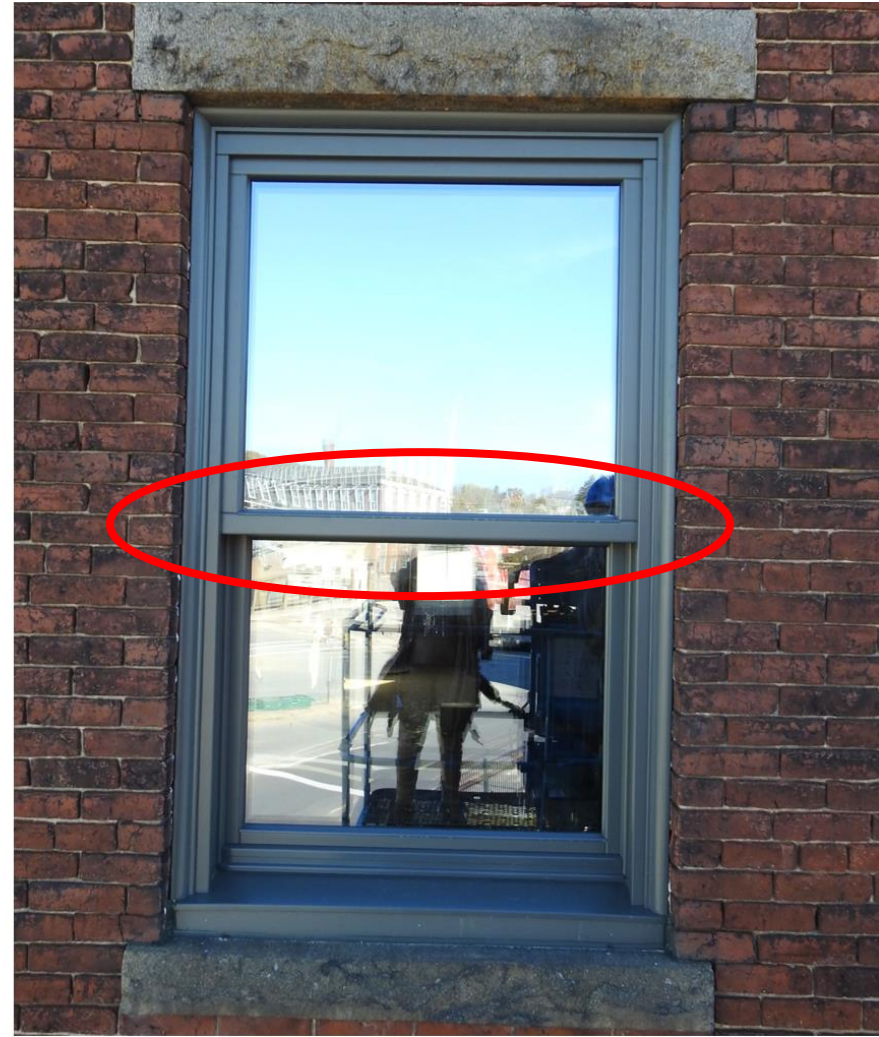


Installation 2

Too Bulky – Meeting Rail Profile

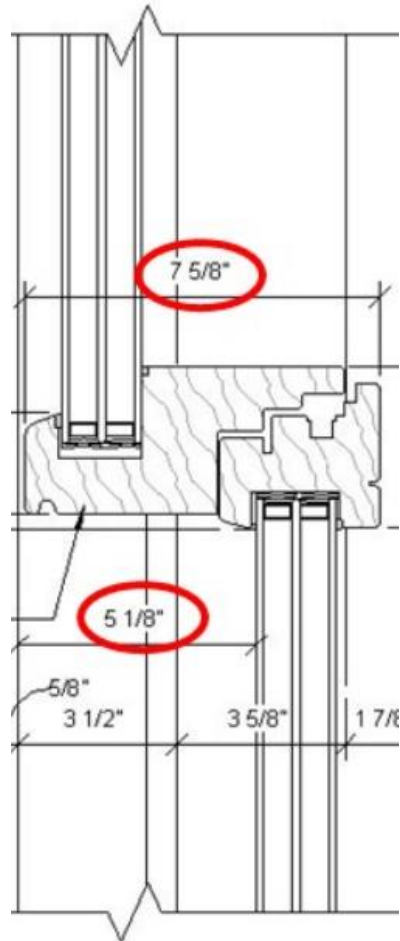


Original Historic Window

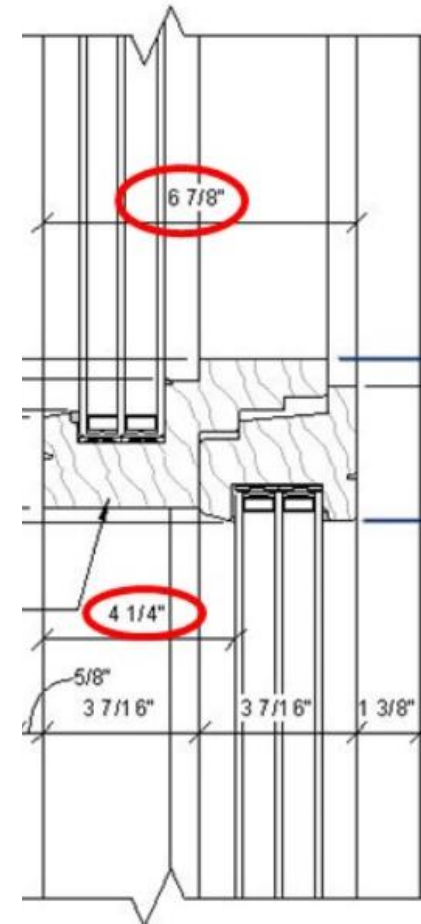


Simulated Double Hung Casement Window

Meeting Rail



Mockup 1



Original Proposal to NPS

wall section depth



Firehouse – Exposed Brick



Firehouse existing conditions – 2nd floor



Firehouse Attic



~ 5'6"

Firehouse existing conditions – 2nd floor



Harper Building – Existing Conditions



Harper Building

new wall surface

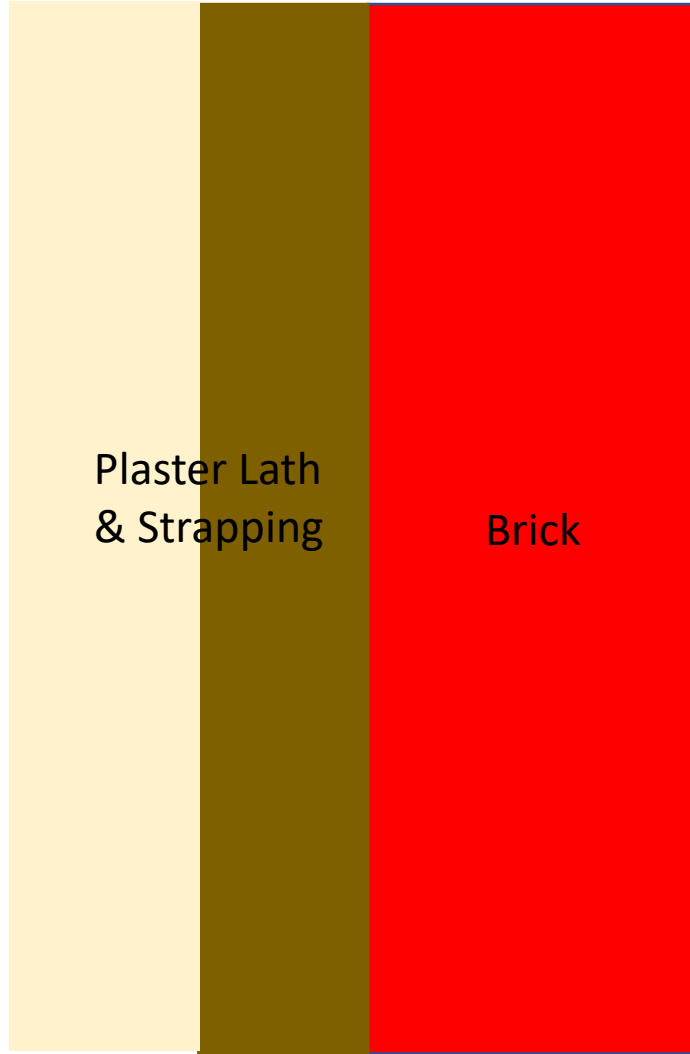
Plaster Lath
& Strapping

Brick

4"

2 1/8" - 2 1/4"

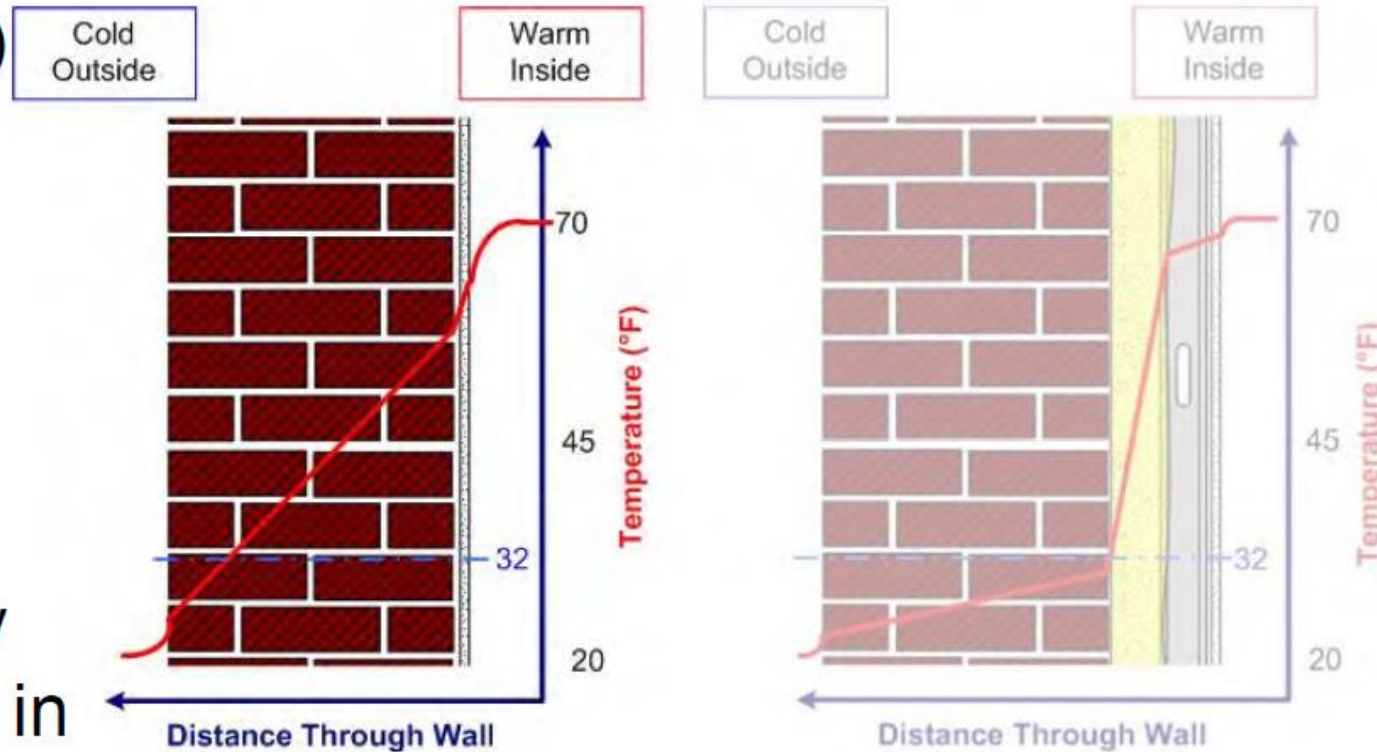
6 1/8 - 6 1/4" from brick to new wall surface



Foam-Free Insulation and Air Sealing

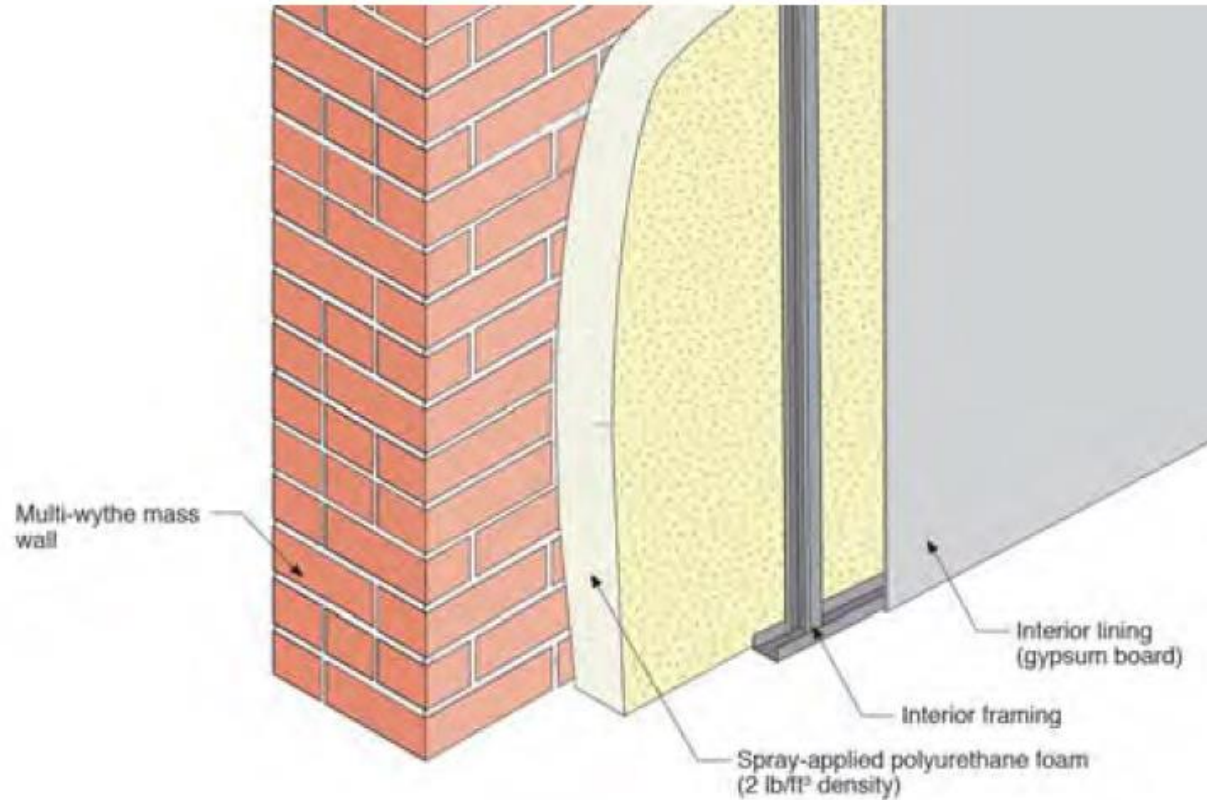
Cold Climate Risks

- Freeze-thaw (reduced drying)
- Air leakage condensation on interior face of masonry
- Rot / corrosion of embedded elements
- Covering interior → less early warning of damage problems in the wall

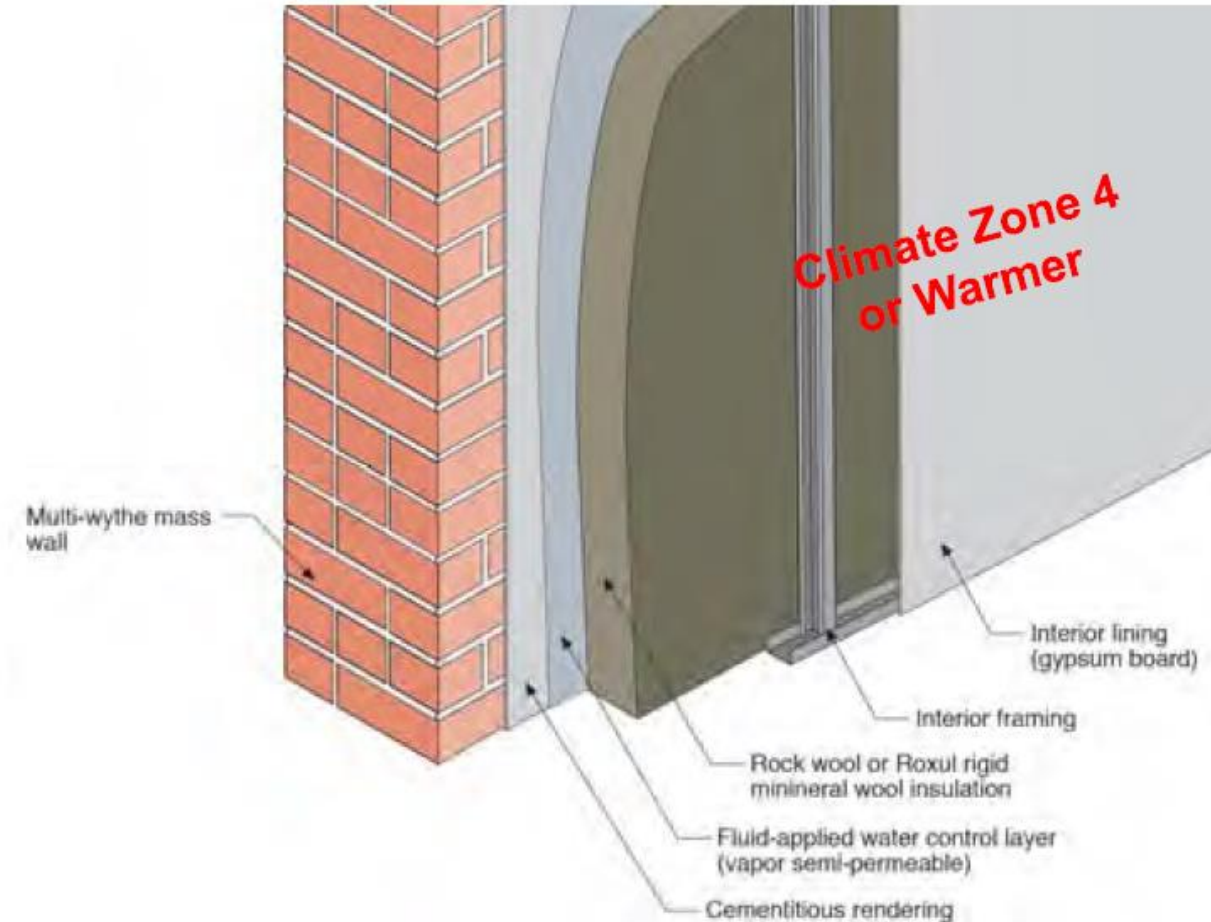


Masonry Interior Insulation Retrofit Assemblies

Closed-cell spray foam



Semi-rigid mineral fiber board



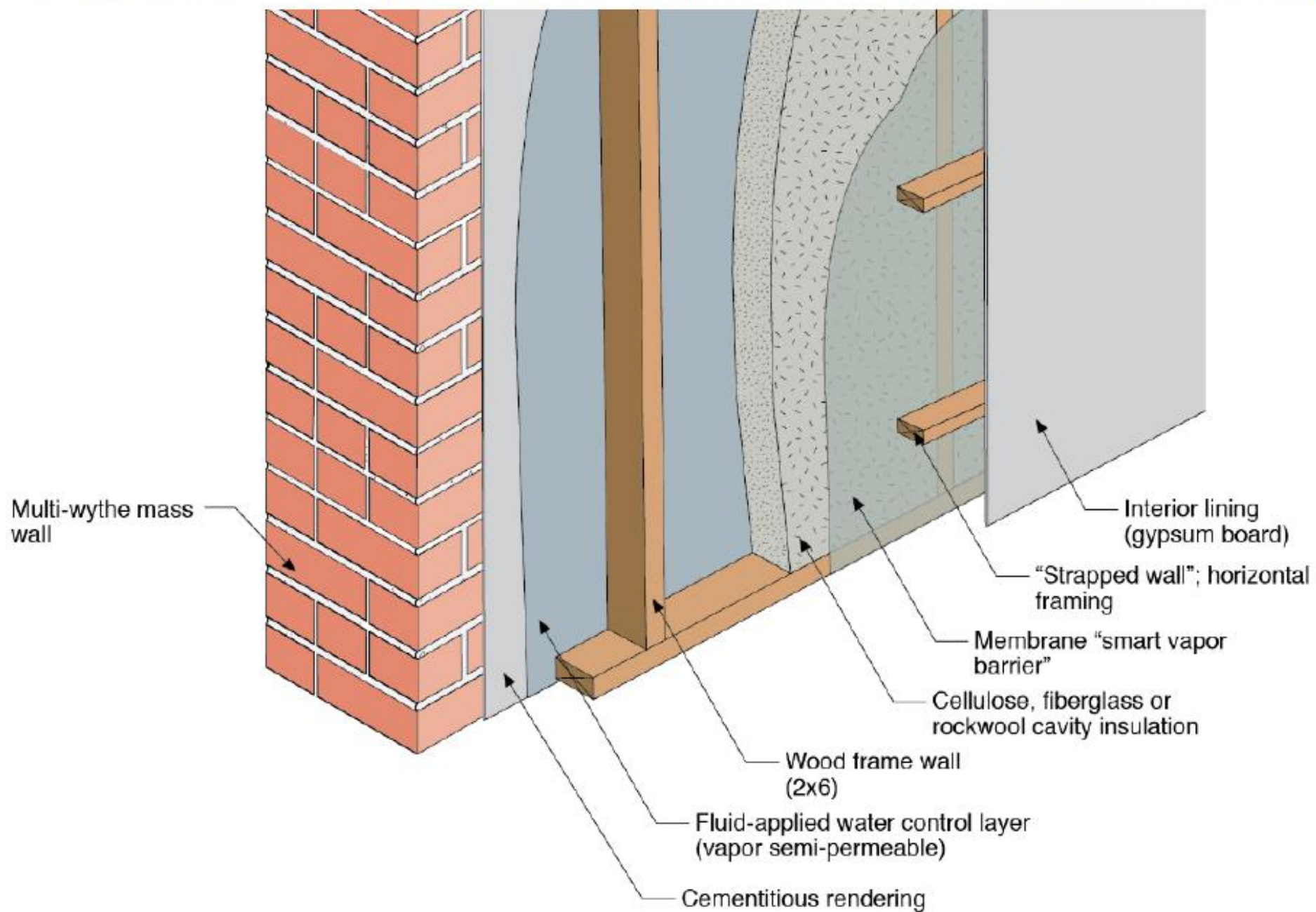
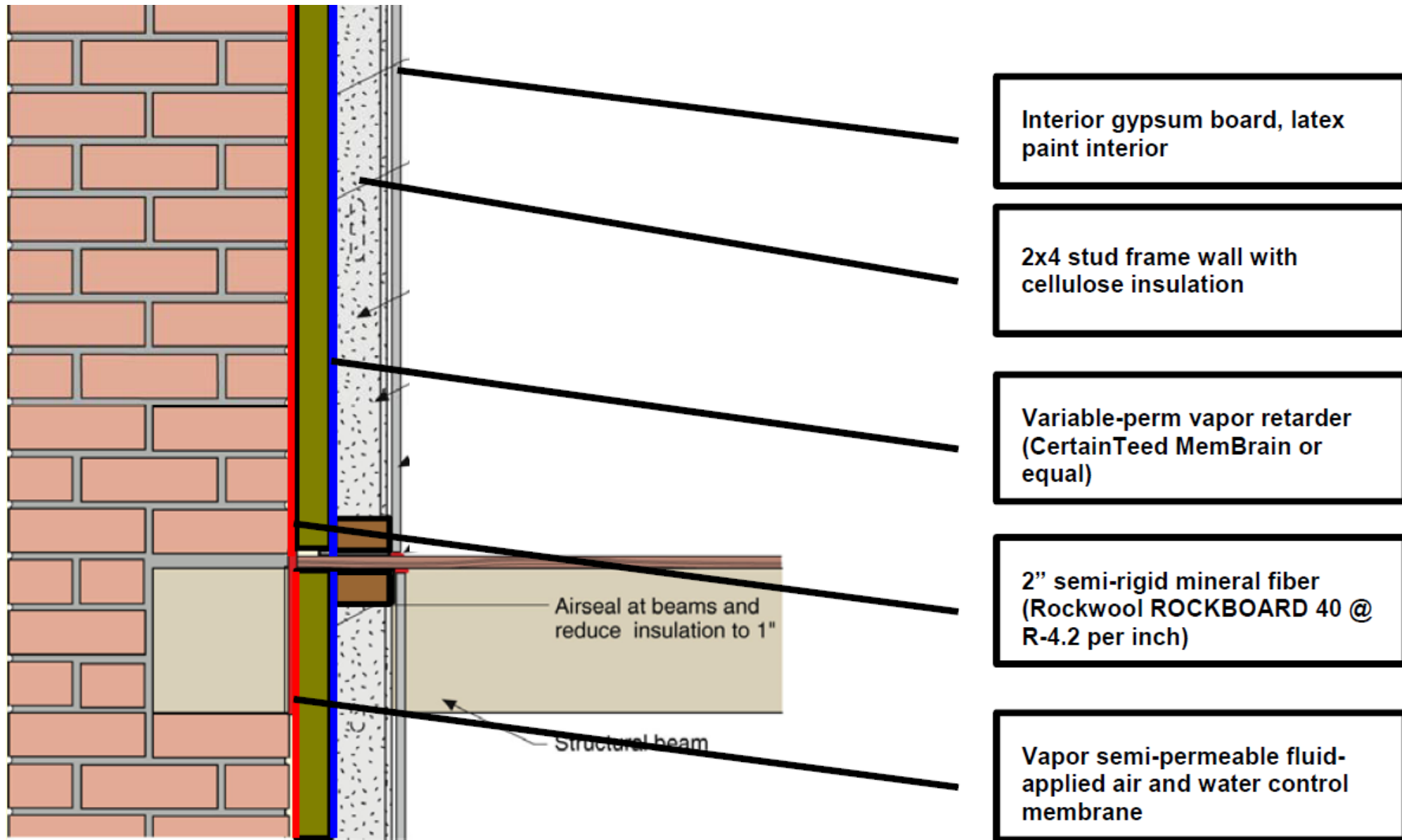


Figure 167: Stud wall with cavity insulation and service cavity (BSI-105)



Interior gypsum board, latex paint interior

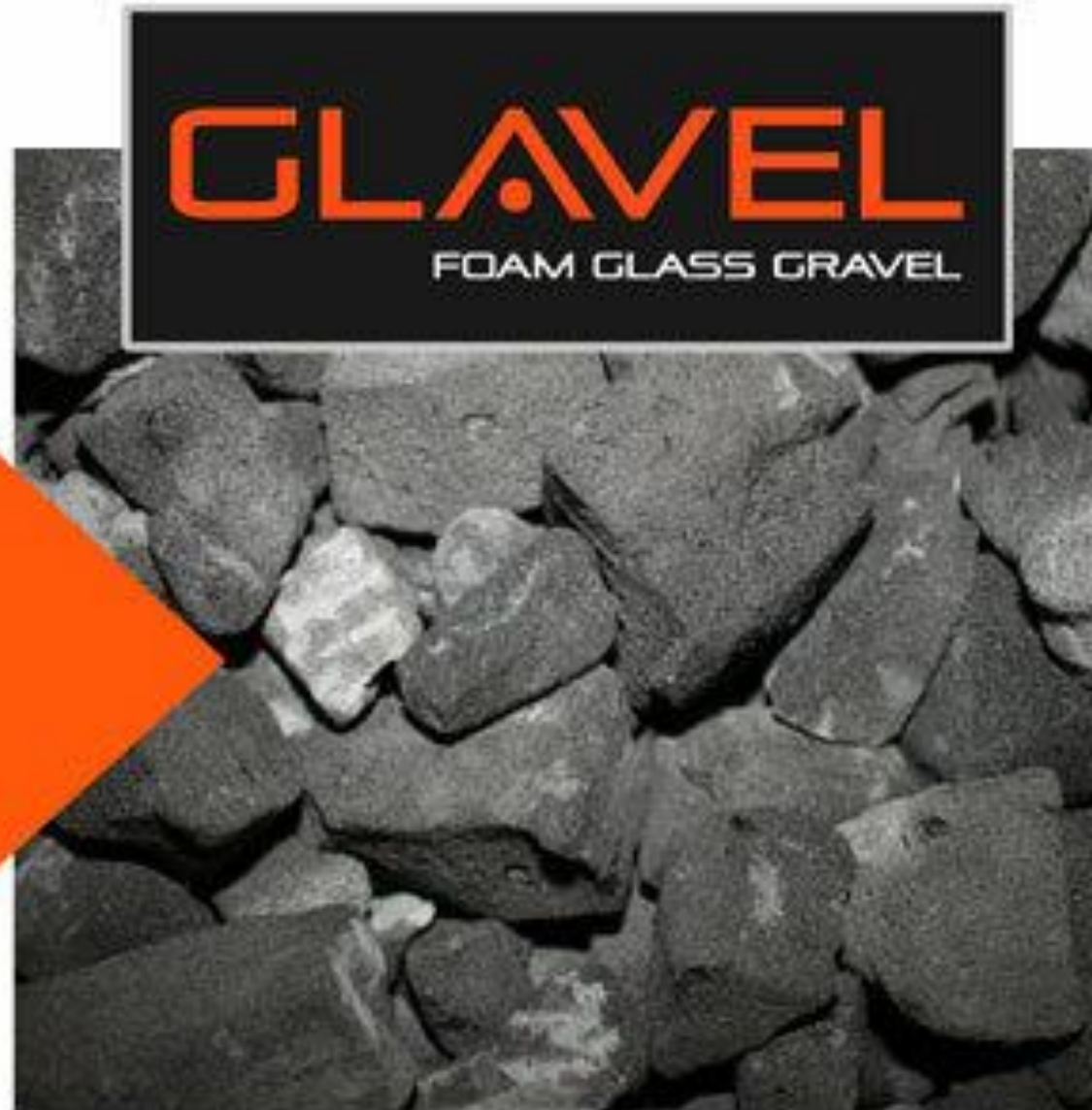
2x4 stud frame wall with cellulose insulation

Variable-perm vapor retarder (CertainTeed MemBrain or equal)

2" semi-rigid mineral fiber (Rockwool ROCKBOARD 40 @ R-4.2 per inch)

Vapor semi-permeable fluid-applied air and water control membrane

Figure 163: Conceptual drawing of mineral fiber and cellulose insulation option



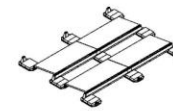
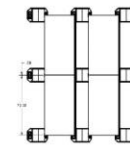
Harper Building - Storefront



Solar



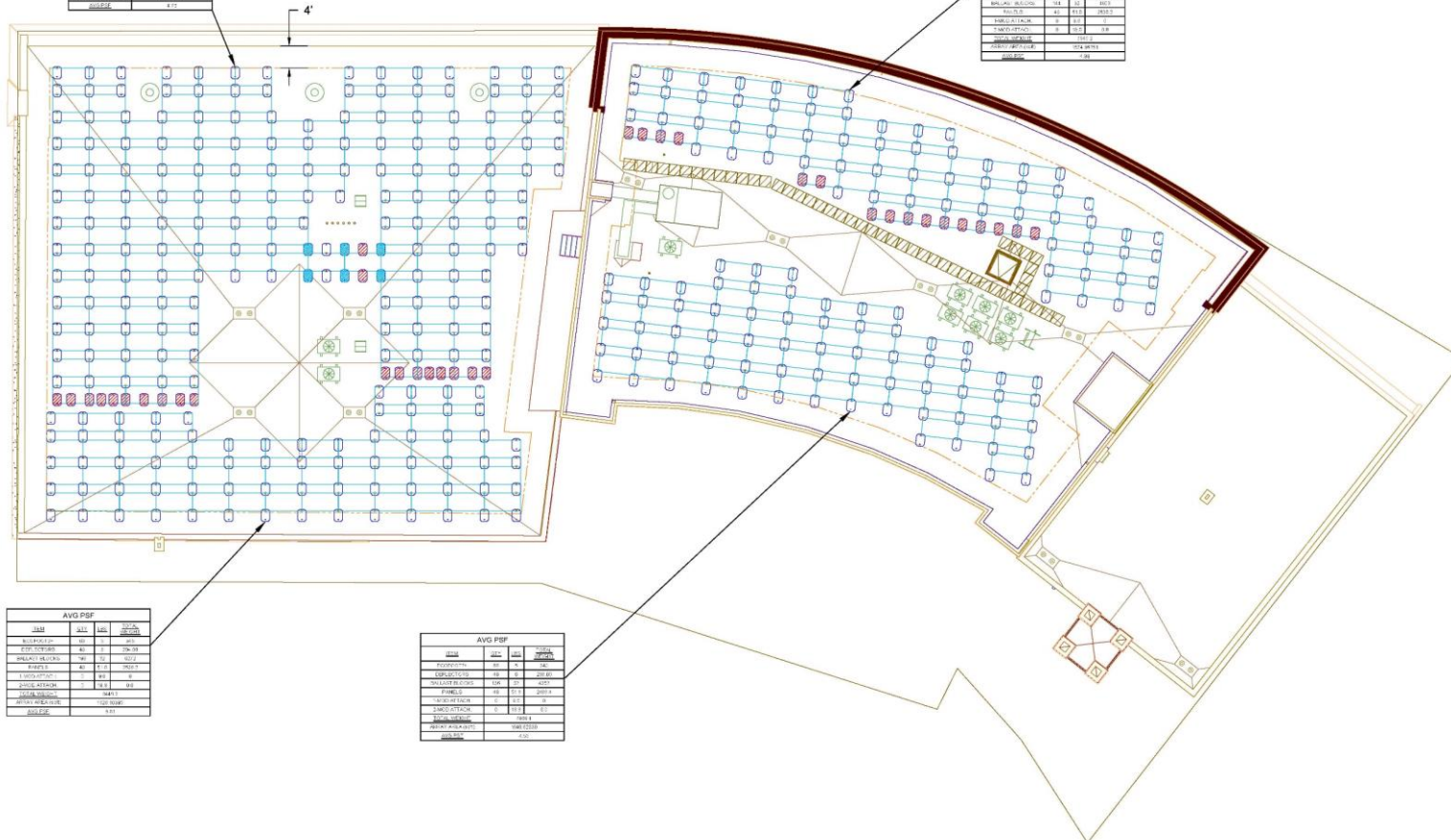
100 KW Solar



HANMHA Q CELLS 380W
ECOFOOT2+ LANDSCAPE ELEVATION VIEW
SCALE: NTS UNITS: INCHES

AVG PSF			
ITEM	QTY	UNIT	TOTAL WEIGHT
ECOFOOT2+	1	EA	100.00
UNIVERSAL CLAMP KIT (ES10486)	1	EA	100.00
WIND DEFLECTOR (ECO-002_311C)	1	EA	100.00
ECOFOOT MLPE BRACKET (ES10970)	1	EA	100.00
3IP BONDING JUMPER (ES10376)	1	EA	100.00
LOWER MID-SUPPORT (ES10488)	1	EA	100.00
UPPER MID-SUPPORT (ES10502)	1	EA	100.00
1.5/8" X 1.5/8" 12 GAUGE STRUT (307)	1	EA	100.00
32 LBS BALLAST BLOCK (ES10100)	1	EA	100.00
TOTAL	1	EA	100.00

AVG PSF			
ITEM	QTY	UNIT	TOTAL WEIGHT
ECOFOOT2+	10	EA	1000.00
UNIVERSAL CLAMP KIT (ES10486)	10	EA	1000.00
WIND DEFLECTOR (ECO-002_311C)	10	EA	1000.00
ECOFOOT MLPE BRACKET (ES10970)	10	EA	1000.00
3IP BONDING JUMPER (ES10376)	10	EA	1000.00
LOWER MID-SUPPORT (ES10488)	10	EA	1000.00
UPPER MID-SUPPORT (ES10502)	10	EA	1000.00
1.5/8" X 1.5/8" 12 GAUGE STRUT (307)	10	EA	1000.00
32 LBS BALLAST BLOCK (ES10100)	10	EA	1000.00
TOTAL	10	EA	1000.00



AVG PSF			
ITEM	QTY	UNIT	TOTAL WEIGHT
ECOFOOT2+	40	EA	4000.00
UNIVERSAL CLAMP KIT (ES10486)	40	EA	4000.00
WIND DEFLECTOR (ECO-002_311C)	40	EA	4000.00
ECOFOOT MLPE BRACKET (ES10970)	40	EA	4000.00
3IP BONDING JUMPER (ES10376)	40	EA	4000.00
LOWER MID-SUPPORT (ES10488)	40	EA	4000.00
UPPER MID-SUPPORT (ES10502)	40	EA	4000.00
1.5/8" X 1.5/8" 12 GAUGE STRUT (307)	40	EA	4000.00
32 LBS BALLAST BLOCK (ES10100)	40	EA	4000.00
TOTAL	40	EA	4000.00

AVG PSF			
ITEM	QTY	UNIT	TOTAL WEIGHT
ECOFOOT2+	80	EA	8000.00
UNIVERSAL CLAMP KIT (ES10486)	80	EA	8000.00
WIND DEFLECTOR (ECO-002_311C)	80	EA	8000.00
ECOFOOT MLPE BRACKET (ES10970)	80	EA	8000.00
3IP BONDING JUMPER (ES10376)	80	EA	8000.00
LOWER MID-SUPPORT (ES10488)	80	EA	8000.00
UPPER MID-SUPPORT (ES10502)	80	EA	8000.00
1.5/8" X 1.5/8" 12 GAUGE STRUT (307)	80	EA	8000.00
32 LBS BALLAST BLOCK (ES10100)	80	EA	8000.00
TOTAL	80	EA	8000.00

MODULE NOTES

- PV MODULE SPEC (P) 380
- PV MODULE QUANTITY 225
- SYSTEM POWER RATING (DC RATED) 100.38
- ORIENTATION/TLT (DEGREE) LANDSCAPER 54°

BALLAST NOTES

- BALLAST BLOCK 18"X18" @ 32 LBS
- ECOFOOT 2+ BLOCK PER EQZ:

- EQZ1: 0
- EQZ2: 0
- EQZ3: 0

AREA OF SHEET APPROX. 100 SQ. FT.

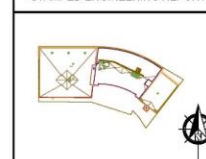
BILL OF MATERIALS

NAME	QTY
ECOFOOT2+ (ECO-002_207)	388
UNIVERSAL CLAMP KIT (ES10486)	328
WIND DEFLECTOR (ECO-002_311C)	272
ECOFOOT MLPE BRACKET (ES10970)	0
3IP BONDING JUMPER (ES10376)	46
ATTACHMENT (PART NUMBER TEST)	0
LOWER MID-SUPPORT (ES10488)	272
UPPER MID-SUPPORT (ES10502)	544
1.5/8" X 1.5/8" 12 GAUGE STRUT (307)	0
32 LBS BALLAST BLOCK (ES10100)	766

SITE NOTES

BASIC WIND SPEED (MPH)	120
EXPOSURE CATEGORY	B
GROUND SNOW LOAD (PSF)	60
OCCUPANCY CATEGORY	II
SEISMIC (SH)	203
ROOF HEIGHT (FT)	56
PARAPET HEIGHT (IN)	0
ROOF SLOPE (DEG)	1.19
ROOFING TYPE	TPO MEMBRANE
ASCE7 VERSION	2010
BUILDING CODE	2012

DRAWING INDICATES PLACEMENT OF EQUIPMENT AND BALLAST. PLEASE REFER TO INSTALLATION MANUAL FOR FULL PRODUCT DETAILS. INSTALLER IS RESPONSIBLE FOR VERIFICATION OF SITE AND PROJECT SPECIFICS. DESIGN IS FINALIZED WHEN ACCOMPANIED BY STAMPED ENGINEERING REPORT.



NO.	REVISION	BY	DATE
A	REVISED - 2/20/21	AC	2020-02-20

SHOP DRAWINGS NOT FOR CONSTRUCTION

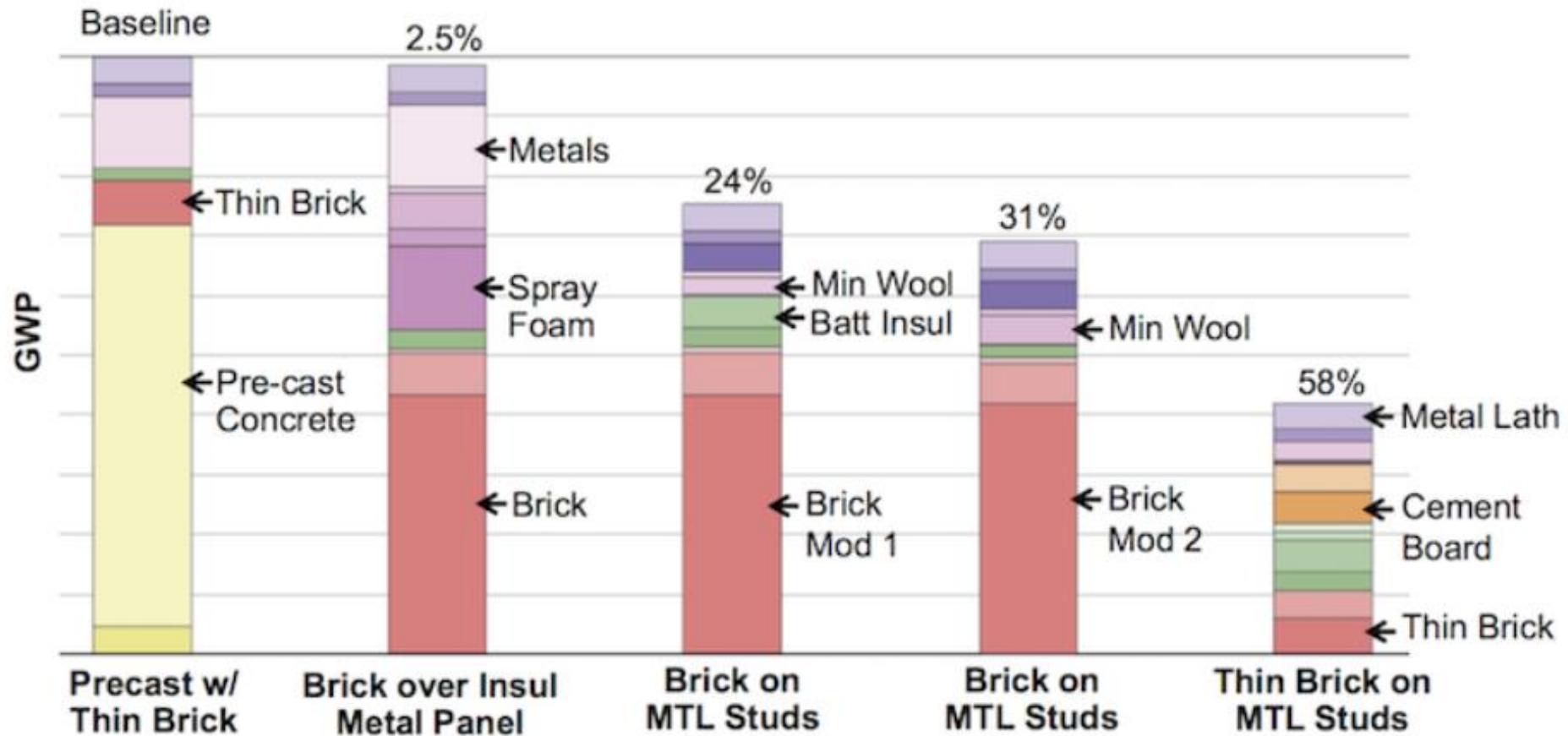
ECOLIBRIUM SOLAR
507 RICHLAND AVE., SUITE 301
ATHENS, OH, 45701

PRODUCED FOR: SUNBUG SOLAR
PROJECT NAME: MORAN SQUARE
10 MAIN ST
FITCHBURG, MA 01420

DATE: 2020-07-08
SCALE: 3/32" = 1'-0"
DRAWN BY: AUDRA COCHRAN
SHEET: S-1.0

Material Reduction	Historic Building Reuse	Achieved
Energy	Passive House + Solar PV	Achieved
Concrete	Reduce Portland, Increase Fly Ash	Achieved
Siding on new building	FSC Wood, no brick/no fiber cement	National Park Service Requirement
Insulation	Cellulose, eco-fiberglass, mineral wool, Glavel	Wall section = cellulose and fiberglass. Demising walls (acoustic) = eco-fiberglass. Under slab = Glavel. Ceiling of parking garage (compromise!) – low HFO foam No XPS!!!
Dimensional framing	Wood instead of steel	???
Windows	Wood	Some
Flooring		No carpet! Reuse of some existing wood flooring. Forbo marmoleum. LVT (Interface says carbon neutral)
Countertops	Wilsonart and Formica	Greenguard and recycled content
Sheetrock	EcoSmart	???
Cabinets	FSC	No good options. Using wood.
Wood	FSC	No

A Tale of Five Bricks



Architect Brad Benke studied the impacts of brick façade systems and discovered that five functionally equivalent wall types had very different impacts. Thin brick on metal studs, shown at the far right, reduced embodied carbon 58% compared with a baseline wall system (thin brick with precast concrete).

Image: LMN Architects

<https://www.buildinggreen.com/feature/urgency-embodied-carbon-and-what-you-can-do-about-it>

Brick

Greenleaf (31% recycled content)

Thin Brick

Team Coordination and CoVid

Passive House - Yes

Low Carbon Materials - Huh? Where's the checklist, points, certification?